We claim:

1. A micromachined oscillating cantilever system comprising:

a micromachined target cantilever;

a magnetic element disposed on the target cantilever;

a micromachined coil disposed adjacent to the magnetic element and separated therefrom by a predetermined gap, the coil being provided with a current which magnetically couples with the magnetic element to oscillate the target cantilever; and

a transducer coupled to the target cantilever to generate a signal in response to oscillation of the target cantilever.

2. The cantilever system of claim 1 where the micromachined coil comprises at least a partial turn of a planar loop of a micromachined conductive wire.

3. The cantilever system of claim 1 where the micromachined coil comprises a spiral planar loop of a micromachined conductive wire.

4. The cantilever system of claim 1 where the micromachined coil comprises a solenoidal coil of a micromachined conductive wire.

5. The cantilever system of claim 4 where the solenoidal coil further comprises a magnetic core.

6. The cantilever system of claim 5 where the magnetic core has a micromachined, acutely shaped tip to concentrate a magnetic field produced within the core.

7. The cantilever system of claim 2 where the partial turn of the planar loop comprises a quarter turn of circular loop.

8. The cantilever system of claim 1 where the micromachined target cantilever, magnetic element and micromachined coil are substantially coplanar.

9. The cantilever system of claim 1 where the magnetic element comprises an array of nanomagnets.

10. The cantilever system of claim 9 where the array of nanomagnets comprises a plurality of parallel columnar nanomagnets.

11. The cantilever system of claim 1 further comprising a microfluidic device having a microfluidic channel with a planar aspect and where the micromachined

target cantilever, magnetic element and micromachined coil are disposed in the planar aspect of the microfluidic channel.

12. The cantilever system of claim 1 further comprising a dummy micromachined target cantilever disposed in a parallel relationship with the target cantilever and symmetrically disposed with the target cantilever relative to the micromachined coil.

13. The cantilever system of claim 1 further comprising a target spring coupled to the target cantilever about which target spring the target cantilever oscillates and where the transducer comprises a piezoelectric target resistor coupled to the target spring.

14. The cantilever system of claim 13 where the piezoelectric target resistor is formed into the target spring.

15. The cantilever system of claim 13 where the target spring comprises a pair of parallel arms acting as a two-dimensional hinge defining an axis about which the target cantilever oscillates.

16. The cantilever system of claim 15 where the piezoelectric target resistor is formed into each arm of the target spring.

17. The cantilever system of claim 12 further comprising a dummy spring coupled to the dummy cantilever about which dummy spring the dummy cantilever oscillates and where the transducer comprises a piezoelectric dummy resistor coupled to the dummy spring.

18. The cantilever system of claim 17 where the piezoelectric dummy resistor is formed into the dummy spring.

19. The cantilever system of claim 17 where the piezoelectric target resistor and piezoelectric dummy resistor are combined in a circuit to form a balancing bridge, the target cantilever and dummy cantilever being fabricated as substantially duplicate cantilevers.

20. The cantilever system of claim 19 further comprising a preamplifier fabricated on chip with the target cantilever and dummy cantilever.

21. The cantilever system of claim 1 where the coil is a flat, thick micromachined wire of having a resistance of 1 ohm or less.

22. The cantilever system of claim 1 further comprising a plurality of target cantilevers, magnetic elements, coils and transducers combined to provide cantilever systems in an array.

23. The cantilever system of claim 22 wherein at least some of the plurality of target cantilevers are selectively biofunctionalized.

24. A method of actuating a micromachined oscillating cantilever system comprising:

providing a current in a micromachined coil disposed adjacent to a magnetic element disposed on a target cantilever and separated therefrom by a predetermined gap to generate a magnetic field;

coupling the magnetic field with the magnetic element;

oscillating the target cantilever in response to the coupling of the magnetic field with the magnetic element; and

transducing the oscillation of the target cantilever into a signal responsive to oscillation of the target cantilever.

25. The method of claim 24 where providing a current in a micromachined coil comprises flowing a current through a partial turn of a planar loop of a micromachined conductive wire.

26. The method of claim 25 where flowing a current through a partial turn comprises flowing current through a quarter turn of circular loop.

27. The method of claim 24 where providing a current in a micromachined coil provides a current in a coil which is substantially coplanar with the micromachined target cantilever, and magnetic element.

28. The method of claim 24 where providing a current in a micromachined coil provides a current in a spiral planar loop of a micromachined conductive wire.

29. The method of claim 24 where providing a current in a micromachined coil provides a current in a solenoidal coil of a micromachined conductive wire.

30. The method of claim 29 where providing a current in a solenoidal coil further comprises generating a magnetic field in a magnetic core within the solenoidal coil.

31. The method of claim 30 where generating a magnetic field in a magnetic core comprises concentrating the magnetic field through a micromachined, acutely shaped tip and coupling the concentrated magnetic field to the magnetic element.

32. The method of claim 24 where coupling the magnetic field with the magnetic element comprises coupling the magnetic field with an array of nanomagnets.

33. The method of claim 32 where coupling the magnetic field with an array of nanomagnets comprises coupling the magnetic field with a plurality of parallel columnar nanomagnets.

34. The method of claim 24 further comprising providing a microfluidic device having a microfluidic channel with a planar aspect and disposing the micromachined target cantilever, magnetic element and micromachined coil in the planar aspect of the microfluidic channel.

35. The method of claim 24 further comprising:

providing the current in the micromachined coil disposed adjacent to a dummy cantilever and separated therefrom by a predetermined gap;

oscillating the dummy cantilever in response to coupling with the current; and

transducing the oscillation of the dummy cantilever into a signal responsive to oscillation of the dummy cantilever.

36. The method of claim 24 where a target spring is coupled to the target cantilever about which target spring the target cantilever oscillates and where transducing the oscillation of the target cantilever comprises generating a signal through a piezoelectric target resistor coupled to the target spring.

37. The method of claim 36 where generating a signal through a piezoelectric target resistor coupled to the target spring comprises generating a signal through a piezoelectric target resistor formed into the target spring.

38. The method of claim 37 where generating a signal through a piezoelectric target resistor comprises generating a signal through a piezoelectric target resistor formed in a pair of parallel arms acting as a two-dimensional hinge defining an axis about which the target cantilever oscillates.

39. The method of claim 35 where oscillating the dummy cantilever comprises oscillating the dummy cantilever about a dummy spring and where transducing the oscillation of the dummy cantilever comprises generating a signal through a piezoelectric dummy resistor coupled to the dummy spring.

40. The method of claim 39 where generating a signal through a piezoelectric dummy resistor comprises generating a signal through a piezoelectric dummy resistor formed into the dummy spring.

41. The method of claim 39 where transducing the oscillation of the target and dummy cantilevers comprises combining the piezoelectric target resistor and piezoelectric dummy resistor in a circuit to form a balancing bridge, the target

cantilever and dummy cantilever being fabricated as substantially duplicate cantilevers.

42. The method of claim 41 further comprising amplifying an output from the bridge with a preamplifier fabricated on chip with the target cantilever and dummy cantilever.

43. The method of claim 24 where providing the current in the micromachined coil provides the current in a flat, thick micromachined wire of having a resistance of 1 ohm or less.

44. The method of claim 24 further comprising:

providing a current in a plurality of micromachined coils disposed adjacent to a plurality of corresponding magnetic elements disposed on the target cantilevers and separated therefrom by a predetermined gap;

oscillating the plurality of target cantilevers in response to their magnetic couplings; and

transducing the oscillation of the plurality of the target cantilevers into a plurality of corresponding signals responsive to oscillation of the respective target cantilevers combined to provide cantilever systems in an array.

45. The method of claim 44 wherein transducing the oscillation of the plurality of the target cantilevers transduces at least some of the plurality of target cantilevers which are selectively biofunctionalized.